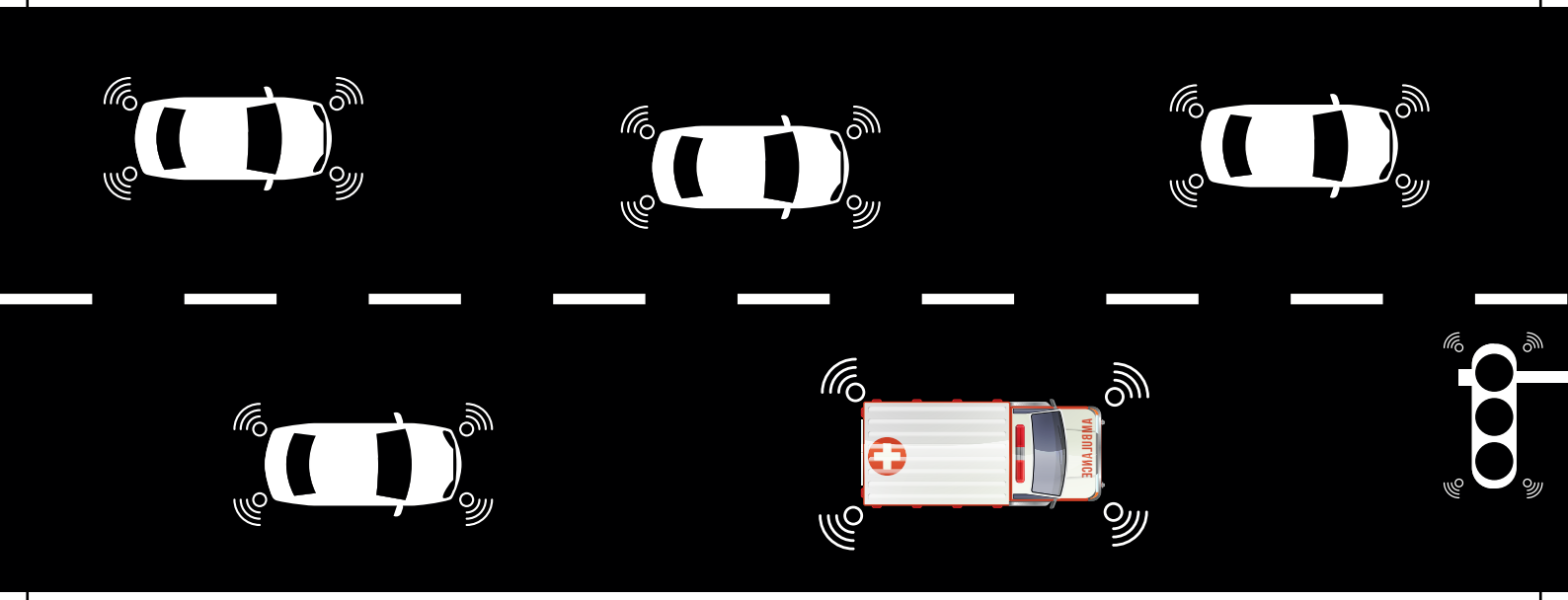
كلية الهندسة
قسم هندسة النظم والحاسبات
SYSTEMS AND COMPUTERS ENGINEERING DEPT.

جامعة الأزهر
AL-AZHAR UNIVERSITY

V2X EMERGENCY ASSISTANCE PRIORITY

PROPOSAL



Under Subervision
DR. KHALID EL-SHAFIE

ABSTRACT

With the rapid advancements in the field of automotive, modern technologies like Vehicle-to-Everything (V2X) communication have emerged as a promising solution to revolutionize transportation systems. This project focuses on harnessing the potential of V2X technology to address the pressing issue of traffic congestion and reduce emergency response times for critical situations.

The V2X Emergency Assistance Priority System aims to optimize emergency services by leveraging the seamless communication between vehicles and infrastructure. When an emergency vehicle is dispatched, it broadcasts signals to surrounding vehicles and traffic lights, notifying them of its approach and urgency. Simultaneously, the system communicates with the leading vehicle, prompting it to make way for the emergency vehicle, ensuring a clear and swift passage.

Moreover, the system facilitates communication between the vehicle and other vehicles in adjacent lanes, streamlining the transition process for the vehicle between lanes to make a empty lane to emergency vehicle. Additionally, the system collaborates with traffic lights, enabling them to coordinate the movement of the emergency vehicle through intersections by managing signals and temporarily closing lanes for other traffic.

By capitalizing on these cutting-edge technologies, emergency responders can navigate through congested roads more efficiently, significantly reducing response times and saving valuable minutes during critical situations. This project seeks to demonstrate how the integration of V2X communication can improve emergency response services, optimizing traffic flow and ensuring timely assistance during emergencies.

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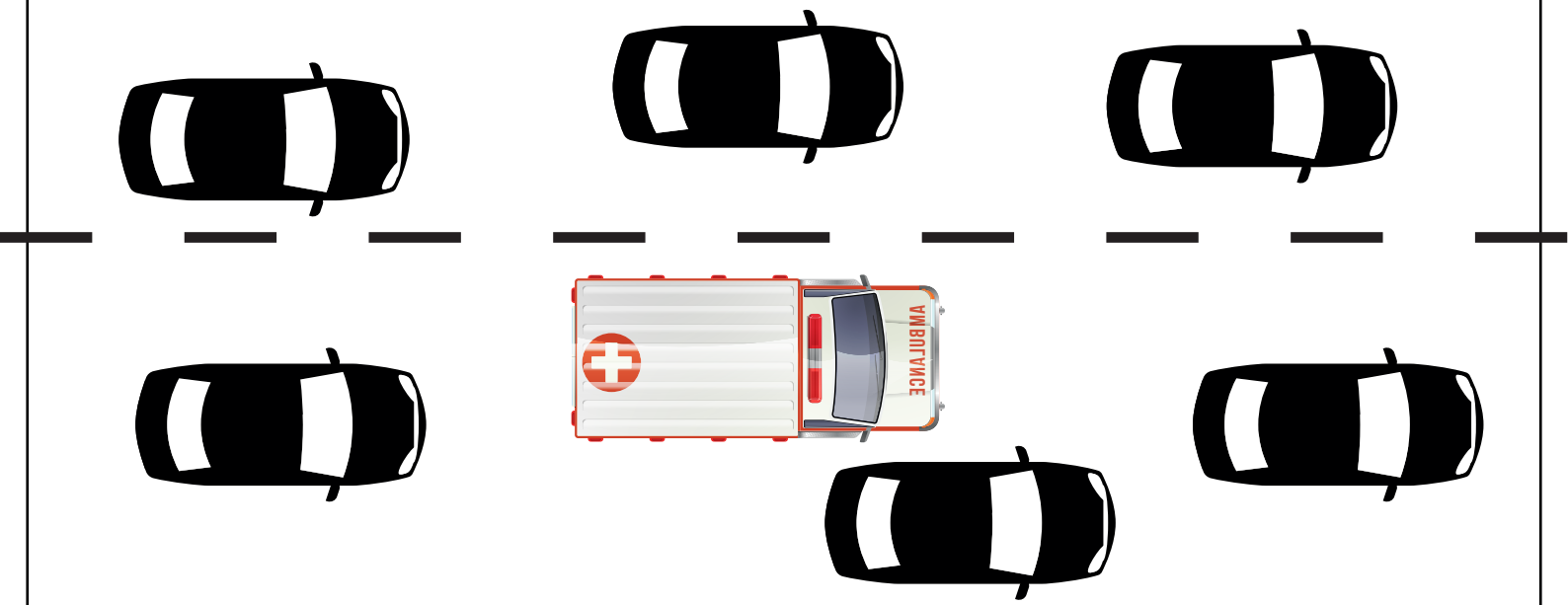


V2X EMERGENCY ASSISTANCE PRIORITY

INTRODUCTION

Traffic congestion poses a significant challenge in today's fast-paced world, impacting various aspects of daily life. However, its consequences can be far more severe when it comes to emergency situations. Being stuck in traffic delays emergency response times, which can lead to the loss of property and valuable lives.

Startling statistics highlight the urgency of timely emergency response. For example, when an ambulance cannot reach its destination within four minutes, the likelihood of survival decreases by %30. Additionally, every minute of delay in ambulance response time raises the mortality risk by %17-8 across all emergencies. Conversely, reducing ambulance response time by just one minute can increase the survival rate by %5.2.

To address this critical issue, our project focuses on harnessing the power of Vehicle-to-Everything (V2X) communication technology. By implementing a V2X Emergency Assistance Priority System, we aim to optimize emergency response and reduce traffic-related delays. This innovative system will enable emergency vehicles to navigate through congested roads more efficiently, ensuring faster response times and potentially saving precious lives.

The project is based on

V2X TECHNOLOGY

so what is **V2X** technology?

Vehicle-to-Everything (**V2X**) technology is an innovative communication system that enables vehicles to exchange information with everything in their environment. The "everything" in **V2X** includes other vehicles, infrastructure (such as traffic lights and road signs), pedestrians, and networks (cloud-based systems or servers). This bi-directional communication enables vehicles to interact with their surroundings, enhancing road safety, traffic efficiency, and overall driving experience.

V2X technology is a critical component in the development of connected and autonomous vehicles. It is designed to improve the flow of information on the roads, enabling vehicles to make better decisions and react to changing conditions in real-time.

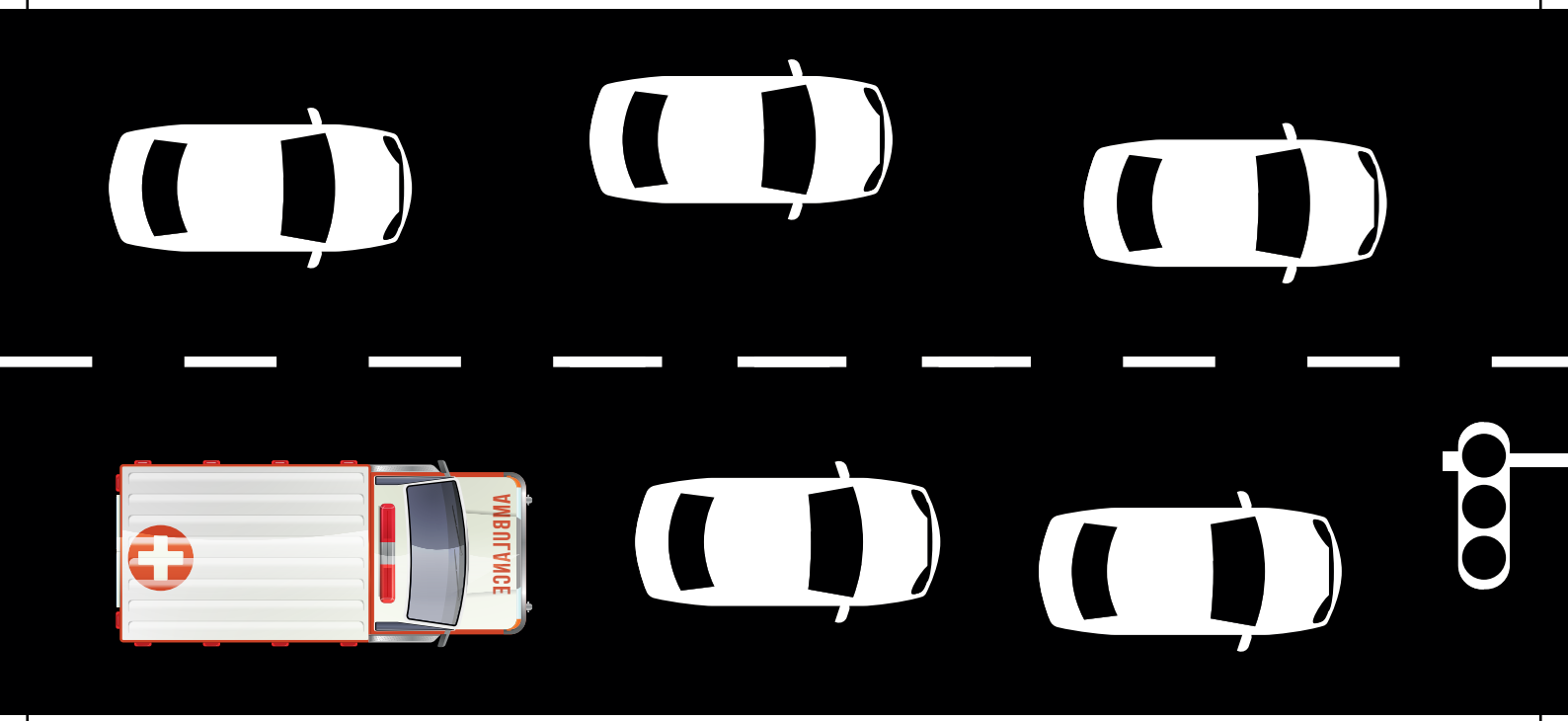
Among all that V2X technology offers, we will utilize V2V and V2I technologies.

V2V (Vehicle-to-Vehicle) communication allows vehicles to directly communicate with each other. It enables the exchange of information, such as speed, location, acceleration, and direction. This real-time communication is essential for cooperative driving applications, collision avoidance, and other safety-related features.

V2I (Vehicle-to-Infrastructure) communication involves vehicles communicating with roadside infrastructure, such as traffic signals, road signs, and intelligent transportation systems. By exchanging data with the infrastructure, vehicles can receive traffic updates, traffic signal information, and other valuable data to optimize their routes and improve traffic flow.

PROPOSED SOLUTION

As we mentioned, we offer a solution to this problem with a system that allows vehicles to communicate with each other and with the infrastructure, and this will be done through several sub-systems

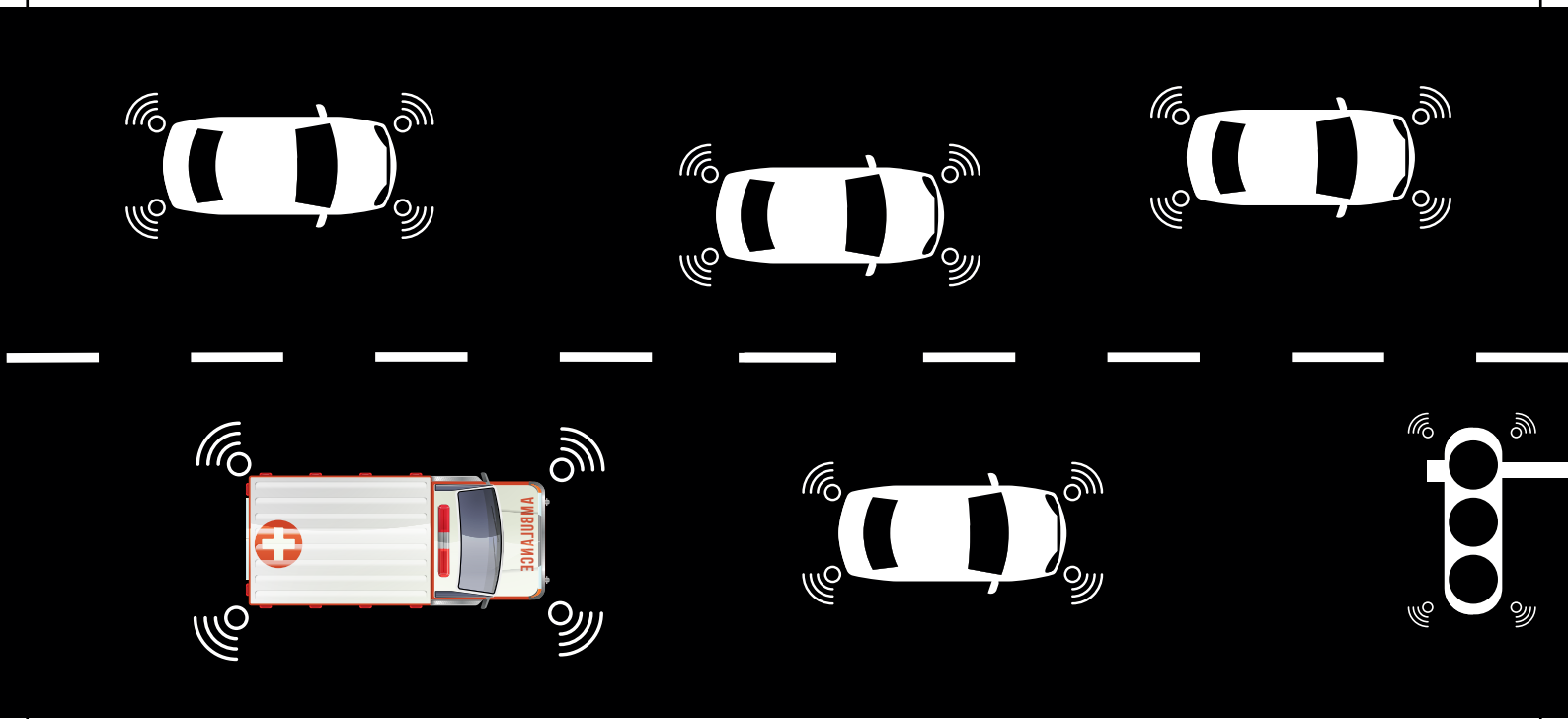


without any communication

1. EMERGENCY DECLARATION

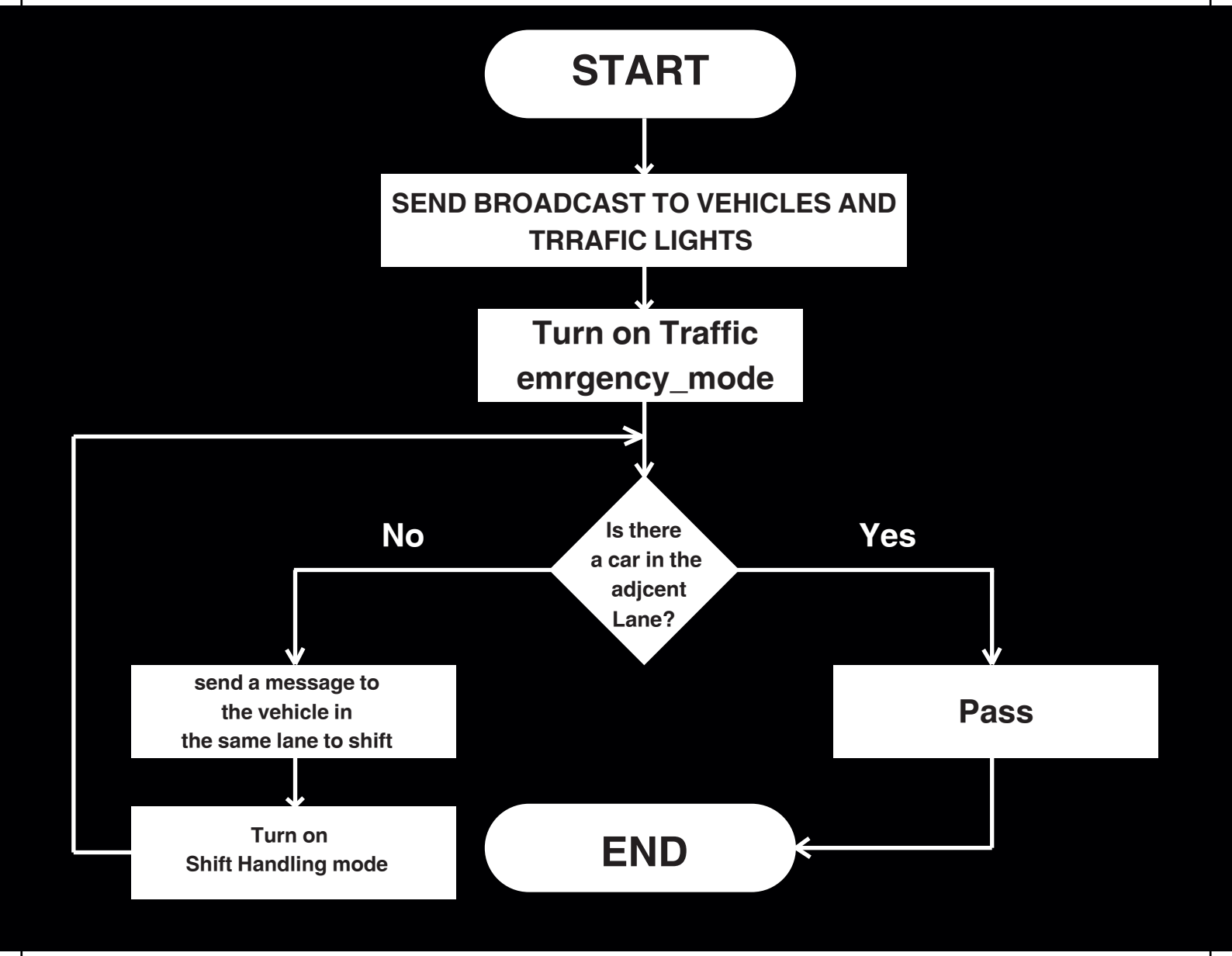
Through this sub-system, all vehicle and traffic lights are informed that there are emergency vehicle coming by some steps:

- Emergency Vehicle will send a signal to the traffic light and all vehicles in front of it on the two lanes of the road.
- Vehicles and The traffic light will receive this signal and activate emergency mode for creating a dedicated lane.
- After verification only Non-EV that caused an obstacle in front of EV will receive a warning message containing some instructions. the driver must obey this message for secure shifting to the other lane.



send the broadcast to vehicles and traffic lights

SUB-SYSTEM FLOWCHART


START
SEND BROADCAST TO VEHICLES AND TRRAFIC LIGHTS
Turn on Traffic emrgency_mode
Is there a car in the adjcent Lane?
No
Yes
send a message to the vehicle in the same lane to shift
Turn on Shift Handling mode
Pass
END

2. SHIFT HANDLING

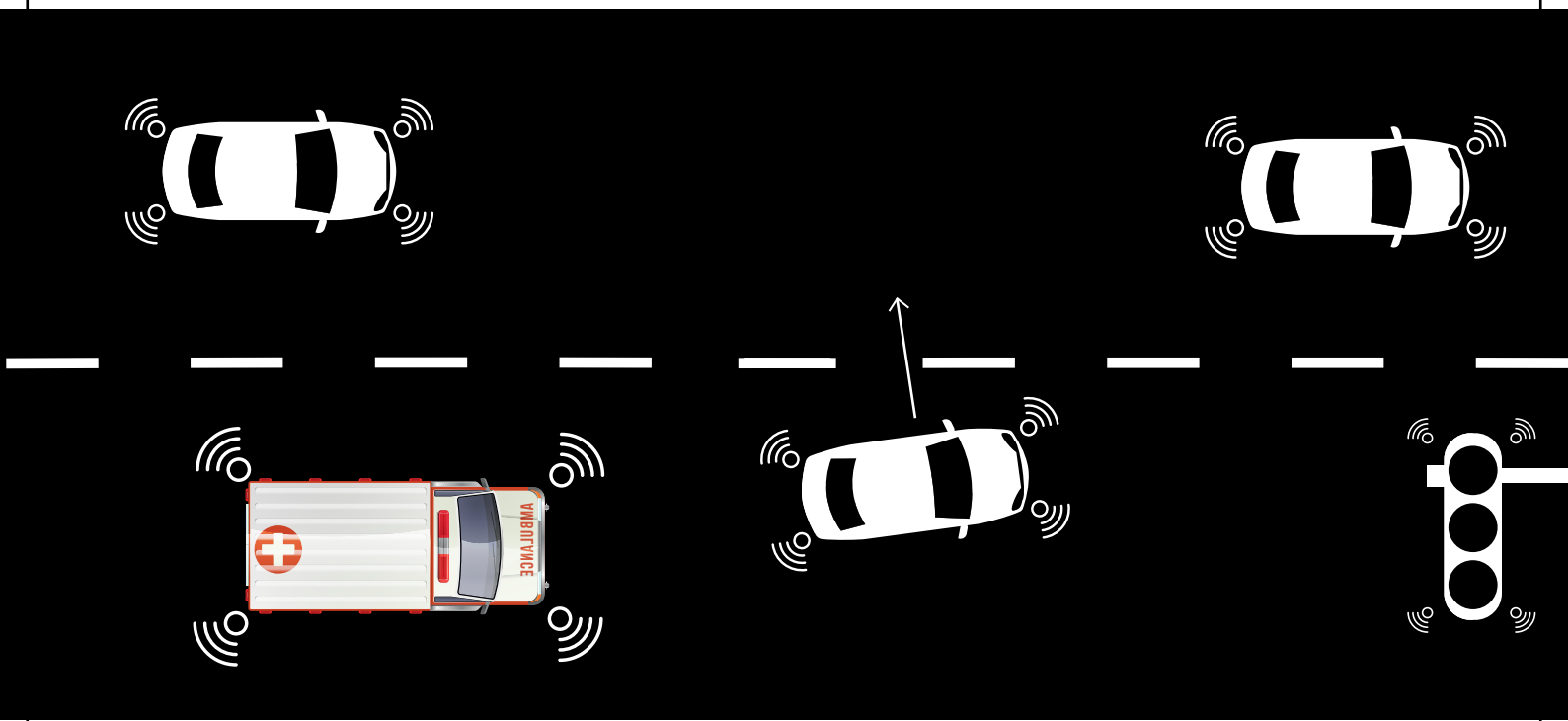
where an emergency vehicle requires a clear path, The cars located in front of it can communicate with the cars in the adjacent lane to widen the road without risking a collision.

Through **V2V** communication:

- The cars in the emergency lane can exchange crucial information with the Surrounding cars, including their positions and intention to move to the other side and create space .

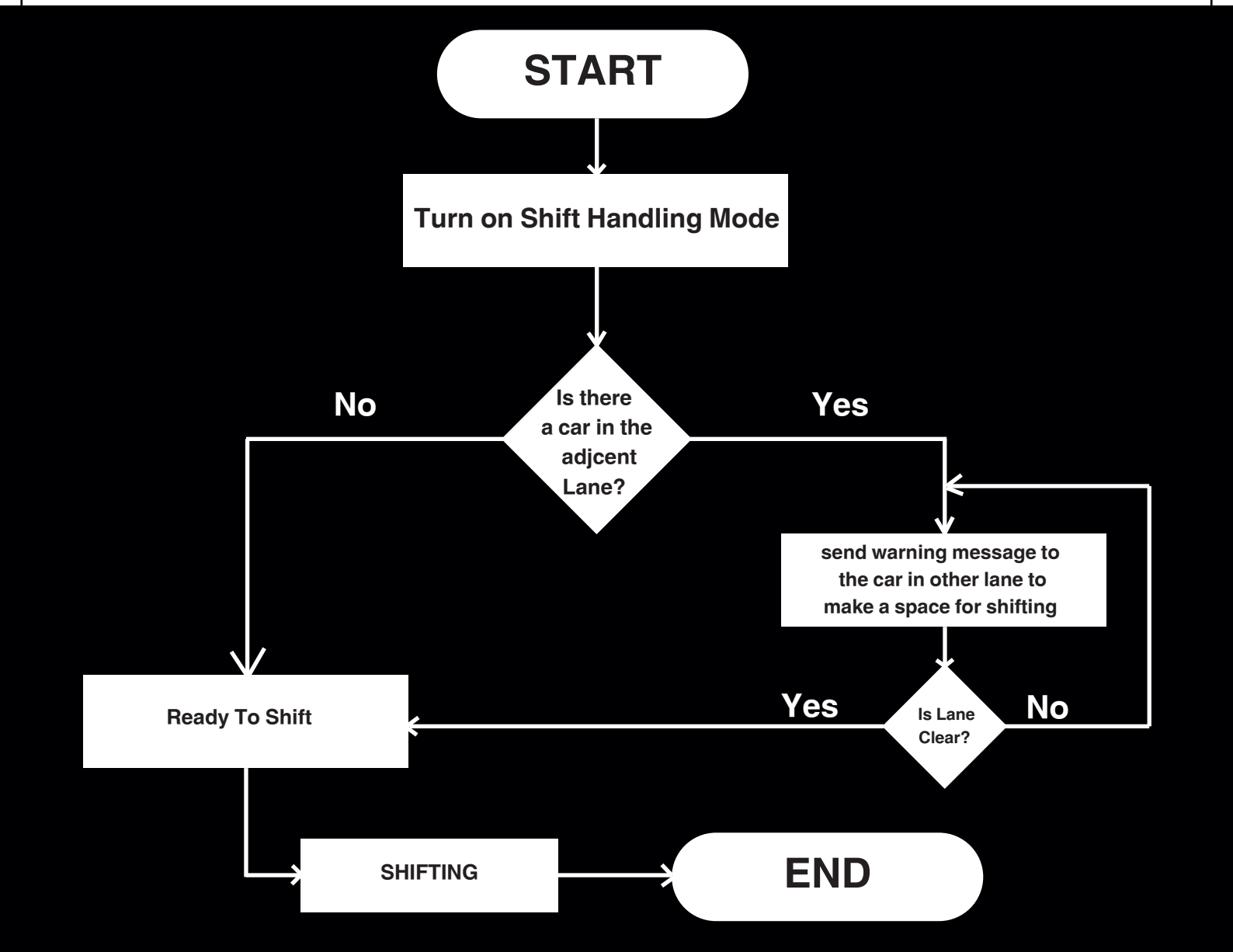
- The car in the other lane, upon receiving this message, can respond by adjusting their positions accordingly, ensuring a synchronized and coordinated movement.

By maintaining constant communication and utilizing their advanced sensing capabilities, the cars can navigate smoothly, avoiding any potential collisions.



Make a Empty Place To Shift

SUB-SYSTEM FLOWCHART



3. INTERSECTION HANDLING

In this sub-system we deal with intersections, so we will make one of the two roads the master one and its intersection the Other one, as well as the traffic light for each one of them

When an emergency vehicle is on the master road, it broadcasts a message to the master traffic light, The master traffic light receives the broadcast and obtains the data of the emergency vehicle, including its speed and location, The master traffic light communicates with the other traffic light.

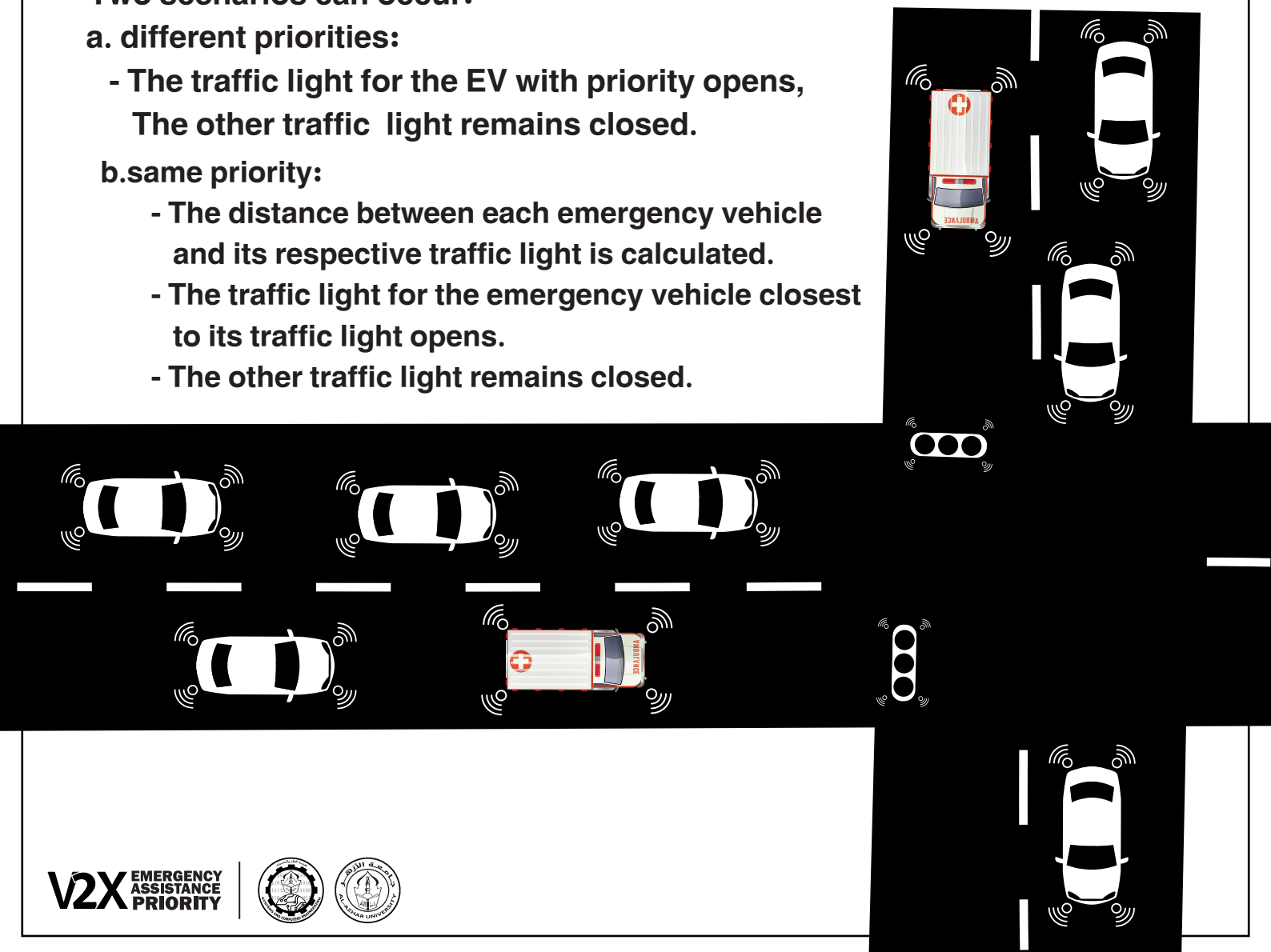
There are two cases:

1. There is No other emergency vehicle on the other road:
- The master traffic light opens.
- The other traffic light remains closed.

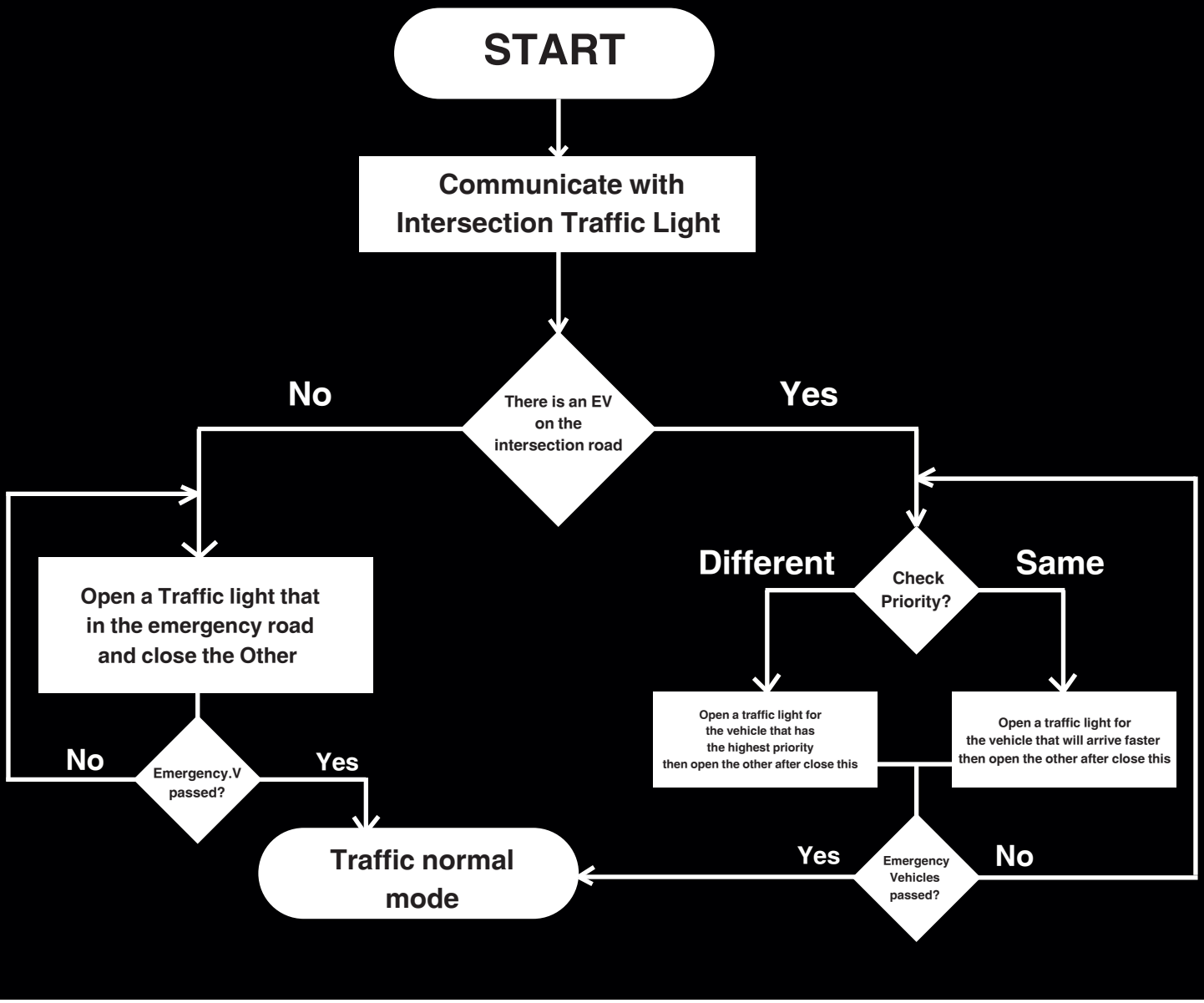
2. Another emergency vehicle on the other road:
- Two scenarios can occur:

a. different priorities:
- The traffic light for the EV with priority opens, The other traffic light remains closed.

b.same priority:
- The distance between each emergency vehicle and its respective traffic light is calculated.
- The traffic light for the emergency vehicle closest to its traffic light opens.
- The other traffic light remains closed.



SUB-SYSTEM FLOWCHART


START
Communicate with Intersection Traffic Light
There is an EV on the intersection road
No
Yes
Open a Traffic light that in the emergency road and close the Other
Emergency.V passed?
No
Yes
Traffic normal mode
Different
Check Priority?
Same
Open a traffic light for the vehicle that has the highest priority then open the other after close this
Open a traffic light for the vehicle that will arrive faster then open the other after close this
Emergency Vehicles passed?
Yes
No

V2X EMERGENCY ASSISTANCE PRIORITY

This is how we can get a solution to the problem by submitting this project

V2X EMERGENCY ASSISTANCE PRIORITY

In the future we can add some other features using artificial intelligence to improve and develop the system

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